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IS 8252-8 (1979): Environmental tests for aircraft equipment, Part 8: Change of temperature [TED 14: Aircraft and Space Vehicles]

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IS : 8252 (Part VIII) - 1979

(Reaffirmed 2005)

Indian Standard

ENVIRONMENTAL TESTS FOR AIRCRAFT EQUIPMENT

PART VIII CHANGE OF TEMPERATURE

Aircraft and Space Vehicles Sectional Committee, EDC 74; Environmental and Operating Conditions for Aircraft Equipment, EDC 74 : 4 [Ref : Doc : EDC 74 (2870)]

1. Scope

1.1 Specifies tests to evaluate the effects of temperature variations on components or equipment used in aircraft. The tests have limited application and should only be specified in the relevant equipment specification when the thermal effects due to a change of temperature are significant to the operation of the equipment. The tests will enable equipment manufacturers to demonstrate that their equipment — when exposed to changes in the local atmosphere — will continue to function, and/or survive.

1.1.1 Two categories of test are described:

a) *Temperature variations* — Generally applicable to equipment likely to suffer gradual changes in atmospheric temperature, and

b) *Thermal shock* — Generally applicable to equipment likely to suffer rapid or instantaneous changes in atmospheric temperature.

1.2 The tests are not suitable for equipment installed in locations where the heat transfer rate is greatly increased by high velocity or turbulent air movement (for example, external to the aircraft or in intake or supercharger ducting), where the temperature change affects only certain parts or surfaces of the equipment (for example, radomes, windscreens, etc), nor is it applicable to equipment which is subjected to thermal shock by contact with a hot fluid (for example, hydraulic components). For such equipment the relevant equipment specification shall detail the appropriate test to be conducted.

2. Description of Test — Two methods of test are specified in this standard; the relevant equipment specification shall state which method is to be adopted.

2.1 *Category A — Temperature Variation Test* — This test method, using a single chamber, the temperature of which can be changed at the specified rate, simulates the temperature changes which result in altitude changes during climb and descent. It is applicable to equipment installed in passenger, freight and light aircraft.

2.2 *Category B — Thermal Shock Test* — This method involves the transfer of the equipment between two test chambers ; it is therefore only suitable for equipment in which the connections are few and are readily made, and the size and mass are such that the equipment can easily be transferred between the two chambers. The method should be used when it is required to simulate a rapid change of temperature, by minimizing the transfer time the temperature changes associated with kinetic heat effects in high speed aircraft can be simulated.

3. Test Procedure

3.1 *Conditions* — The appropriate standard conditions stated in IS : 8252 (Part I) - 1976 ' Environmental tests for aircraft equipment: Part I General ' shall apply.

3.2 *Category A — Temperature Variation Test* — The equipment shall be installed in the test chamber, making such connections as are necessary for the equipment to function and for a performance test to be carried out.

The equipment shall be subjected to one low-to-high temperature cycle as described in **3.2.1** and/or one high-to-low temperature cycle as described in **3.2.2**, as required by the relevant equipment specification. If repeated temperature cycling is required the integration of procedures **3.2.1** and **3.2.2** shall be as given in **3.2.3**.

3.2.1 *Low-to-high temperature* — The temperature of the chamber shall be reduced to the low temperature level required by the relevant equipment specification at a rate not exceeding 3°C per minute, and the condition maintained until the temperature of the equipment has stabilized.

The temperature of the chamber shall then be increased at a rate selected from those given in **4.2**, to the specified high temperature level. The chamber shall be maintained at the high temperature level until the equipment temperature has stabilized, or for such other period as is stated in the relevant equipment specification.

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At the end of this period the chamber temperature shall be allowed to fall to standard laboratory temperature at a rate not exceeding 3°C per minute. The sequence is shown graphically in Fig. 1.

The equipment shall be operated and its performance checked at the phase(s) of the test cycle required by the relevant equipment specification.

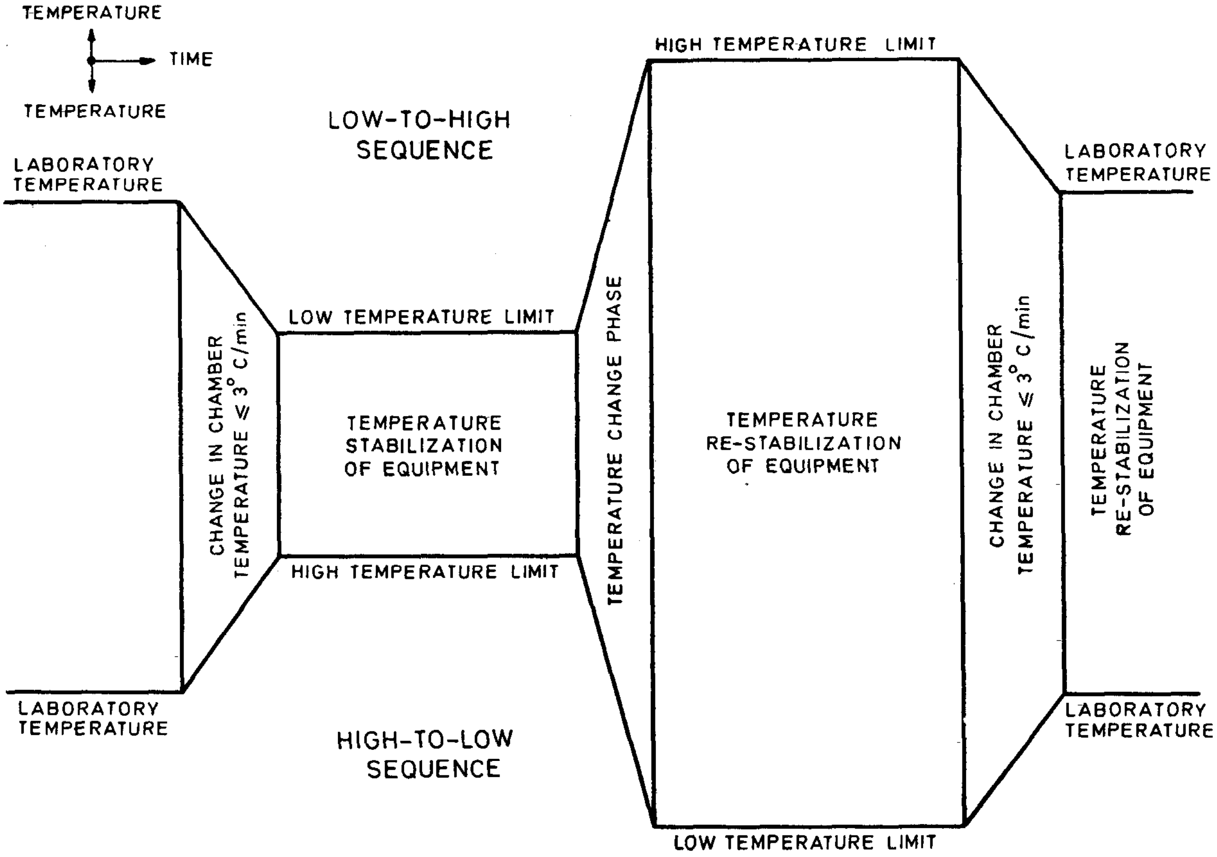

FIG. 1 SINGLE-CYCLE CHANGE OF TEMPERATURE SEQUENCE

3.2.2 *High-to-low temperature* — The procedure shall be similar to that given in **3.2.1** above but with the low and high temperature sequence reversed in the manner shown graphically in Fig. 1.

3.2.3 *Repeated cycling* — When repeated cycling is a requirement of the relevant equipment specification, the procedure given in **3.2.1** shall be carried out up to the stage when the equipment has stabilized at the specified high temperature (that is, a low-to-high temperature change has been achieved).

The equipment shall then be subjected to a high-to-low temperature change in accordance with **3.2.2** and allowed to restabilize at the specified low temperature.

The sequence, shown graphically in Fig. 2, constitutes one cycle.

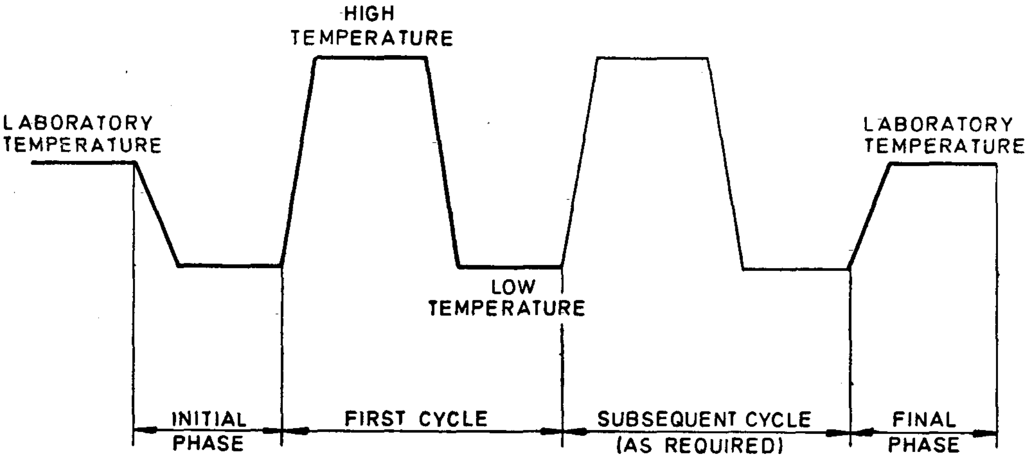

FIG. 2 REPEATED TEMPERATURE CYCLING SEQUENCE

This cycle shall be repeated to complete three such cycles or such number as required by the relevant equipment specification. At completion of the temperature conditioning the chamber temperature shall be returned to standard laboratory conditions at a rate not exceeding 3°C per minute.

3.3 *Category B — Thermal Shock Test* — The volume of the chambers and the air circulation in them affects the recovery conditions for the temperature within the chamber after the equipment is inserted. As such, the volume of the chamber with respect to the volume of equipment should be such so that after insertion of the test specimen, the temperature in the relevant chamber could be brought to the specified value within five minutes or in a period not more than 10 percent of the time required for the equipment stabilization in that chamber.

The equipment shall be subjected to one low-to-high temperature cycle as described in **3.3.1** and/or one high-to-low temperature cycle as described in **3.3.2**, as required by the relevant equipment specification. If repeated temperature cycling is required the integration of procedures **3.3.1** and **3.3.2** shall be as given in **3.3.3**.

3.3.1 *Low-to-high temperature* — The temperature of the chamber shall be reduced to the low temperature level required by the relevant equipment specification at a rate not exceeding 3°C per minute, and the conditions maintained until the equipment has stabilized at the test temperature.

The equipment shall then be removed from the cold chamber and transferred, in a time of not more than 6 min, unless otherwise stated in the relevant equipment specification, to a chamber maintained at the conditions specified for the high temperature level.

The equipment shall be subjected to the high temperature conditions until its temperature has stabilized, or for such other period as may be required in the relevant equipment specification. At the end of this period the chamber temperature shall be allowed to fall to standard laboratory temperature at a rate not exceeding 3°C per minute.

The sequence is shown graphically in Fig. 1.

3.3.2 *High-to-low temperature* — The procedure shall be similar to that given in **3.3.1** above, but with the low and high temperature sequence reversed in the manner shown graphically in Fig. 1.

3.3.3 *Repeated cycling* — When repeated cycling is required by the relevant specification, the procedure given in **3.3.1** shall be carried out up to the stage when the equipment has stabilized at the specified high temperature (that is having been subjected to a low-to-high temperature shock). The equipment shall then be returned to the low temperature chamber and allowed to re-stabilize at the specified low temperature; this constitutes one cycle.

This cycle, shown graphically in Fig. 2, shall be repeated to complete three such cycles or such number as is required by the equipment specification. At the completion of the thermal shock conditioning the chamber temperature shall be returned to standard laboratory temperature at a rate not exceeding 3°C per minute.

The time for transfer between chambers shall not exceed 6 min unless otherwise stated in the relevant equipment specification.

Note — During transfer of the specimen from the cold chamber to the hot chamber (procedures **3.3.1** and **3.3.3**) precautions shall be taken to minimize condensation on the specimen.

4. Test Severities

4.1 *Temperature Limits* — Unless otherwise specified, the temperature limits for the test shall be the low and high operating temperatures appropriate to the equipment category, as specified in Table 2 of IS : 8252 (Part II) - 1979 ' Environmental tests for aircraft equipment : Part II Temperature, pressure and humidity ' (that is, col 4 and 7 respectively).

4.2 *Rate of Change of Temperature* (*Category A only*) — The rate of change of temperature shall, unless otherwise specified, be as listed below depending upon the location of the equipment in the aircraft:

a) Equipment located in temperature controlled zones	2 ± 1°C/min
b) Equipment located in non-temperature controlled zones	5 ± 2°C/min
c) Equipment directly affected by external atmosphere, for example, equipment in undercarriage bays, in close thermal contact with the external airframe in an unheated bay (*see* exclusions in **1**).	10 ± 5°C/min

5. Information to be Stated in the Relevant Equipment Specification — When a change of temperature test is specified in the relevant equipment specification the following information shall be stated, as far as applicable:

	Relevant Clause
a) The test method to be adopted	2
b) Whether the test is to demonstrate performance or survival	
c) If performance is to be assessed the phase(s) of the test cycle when the equipment is to be operated and when a performance evaluation is to be carried out	3.2.1, 3.3.1 and Appendix A
d) The temperature sequence to be adopted	3.2 and 3.3
e) The number of test cycles and if required the method of integrating the low-to-high and high-to-low sequence	3.2 and 3.3
f) The transfer time for category B, if other than 6 min	3.3.1
g) The appropriate equipment classification or the temperature limits to be applied	4.1
h) The equipment location, or the rate of change of temperature to be applied for category A	4.2
j) The duration of exposure to the temperature conditions, if other than achieving stabilization	3.2.1 and 3.3.1

APPENDIX A

[*Clause* 5 (c)]

GUIDANCE FOR CONDUCT OF TESTS

Where there are practical difficulties in rapidly transferring heavy and/or large equipment from one test chamber to another, guidance on the handling of the equipment during this stage should be given in the relevant equipment specification.

A-1. Performance Evaluation

A-1.1 These tests may be invoked to assess the functional performance of an equipment or to check for mechanical defects, such as fracture caused by thermal stresses, seizures of parts because of differential expansion or contraction, etc. The object(s) of the test must be clearly stated in the equipment specification.

A-1.2 Where the performance of the equipment could be affected by temperature gradients induced as a result of those tests (for example, stability of filter networks, accuracy of precision instruments) the equipment may need to be operated throughout the test conditioning phases and the performance of critical parameters monitored throughout the test.

A-1.3 In general, equipment should be operated at the appropriate phase(s) of the test to produce temperature levels representative of the most severe operational and environmental use conditions anticipated. For tests demonstrating survival only, the equipment should be operated and a performance evaluation made when the temperature has been returned to standard laboratory conditions or to a temperature given in the relevant equipment specification.

EXPLANATORY NOTE

This standard is a part of a series of Indian Standards specifying simulated environmental tests to which aircraft equipment is to be subjected to demonstrate that it would function satisfactorily under normal aircraft operating conditions. The relevant equipment specification will define the appropriate test severities and the criteria for correct functioning [*see* IS : 8252 (Part II) - 1979].

This standard is based on draft International Standard ISO/DIS 2657 Environmental tests for aircraft equipment — Part 2.7 Change of temperature, issued by International Organization for Standardization.

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